

Failure Analysis of Failed PMTs

Progress report

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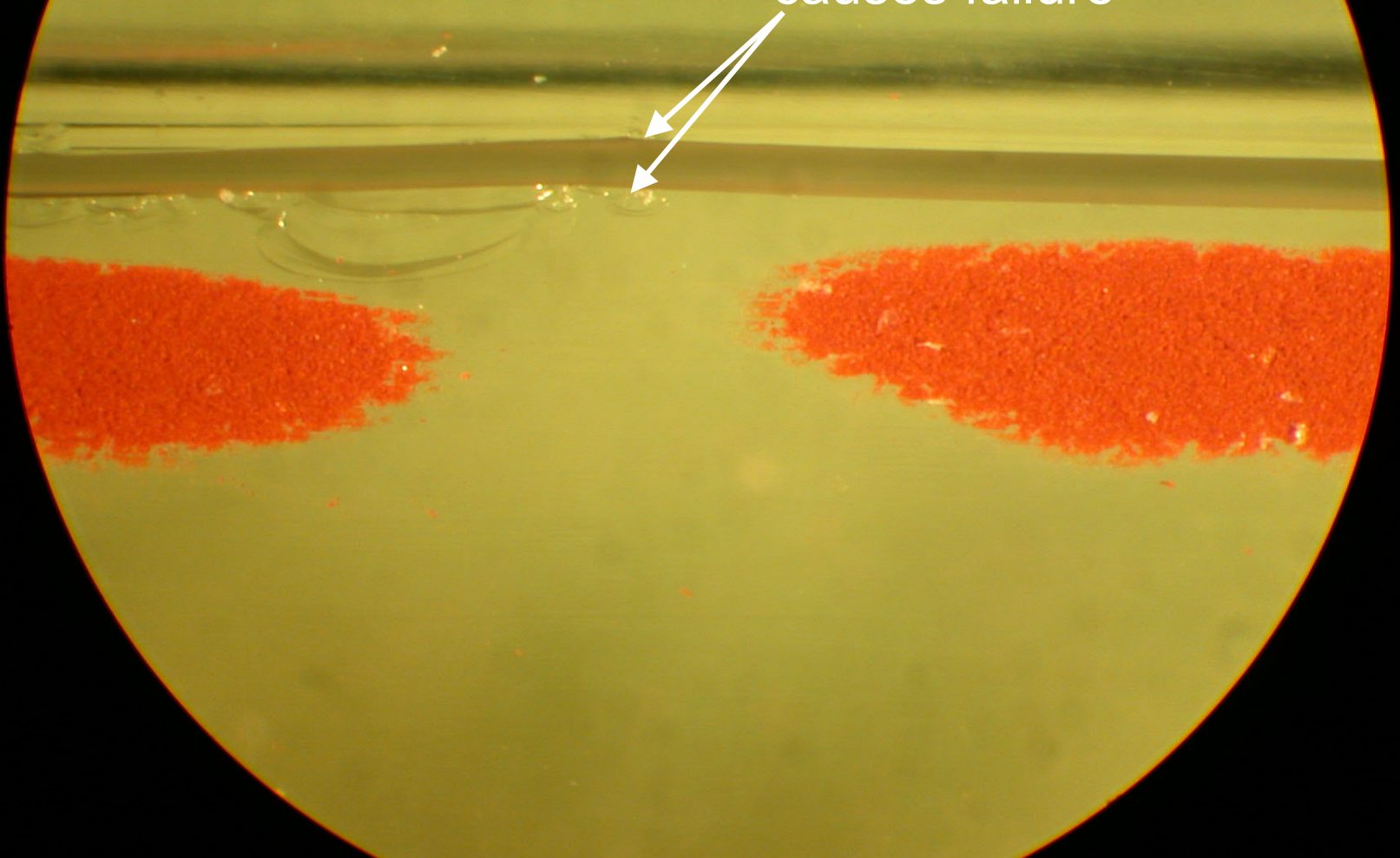
7-19-04

Failed PMT ZL1193

- Fracture origin identified as a chipping/score on outside surface, about 27 mm from base
- Inspection before potting: rated “Worst”, 3 score lines on the outside surface in the middle (1/3) region, severe inside scores

Outside surface of PMT ZL1193

Defect that
causes failure

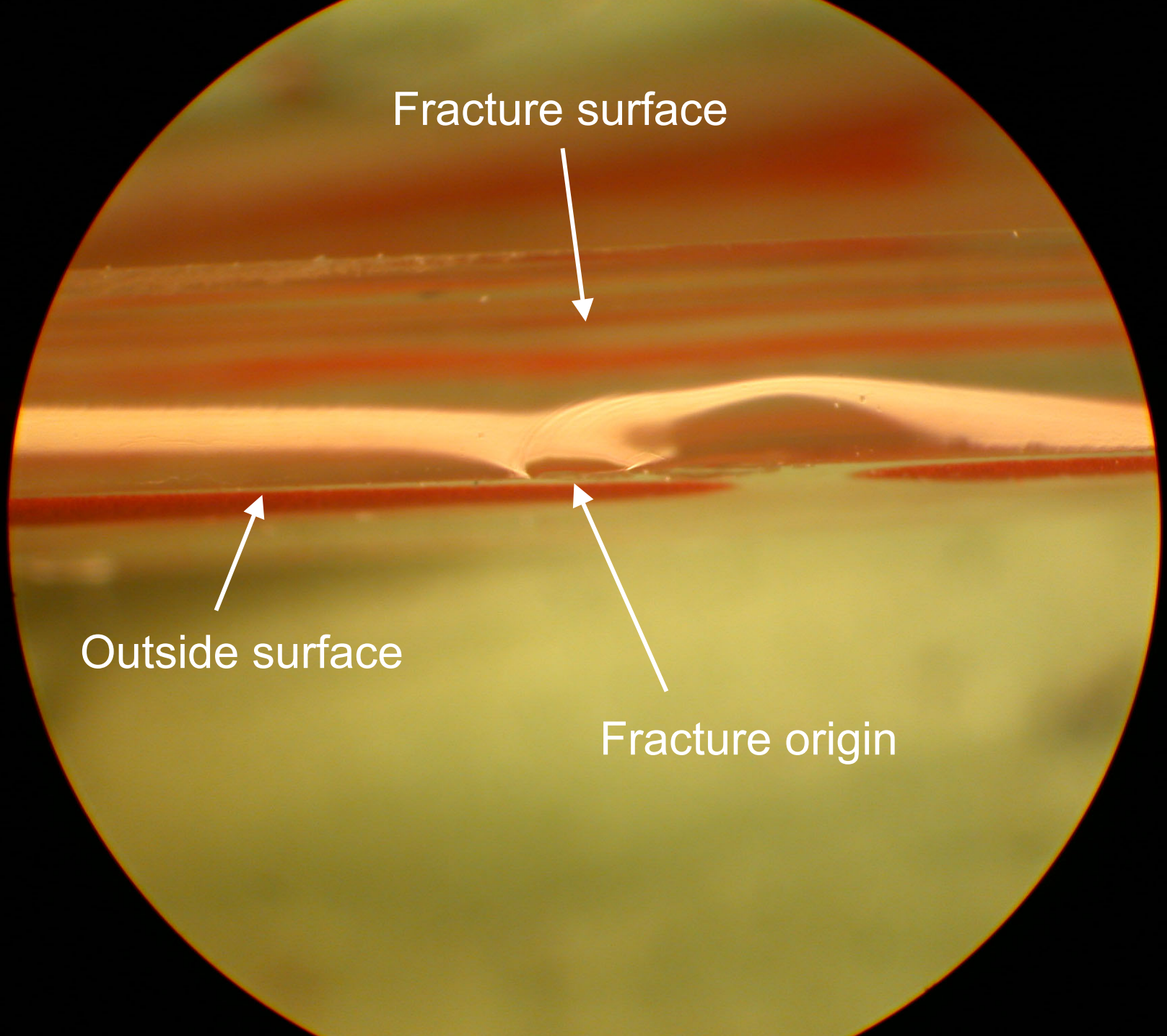


Fracture origin



Fracture origin

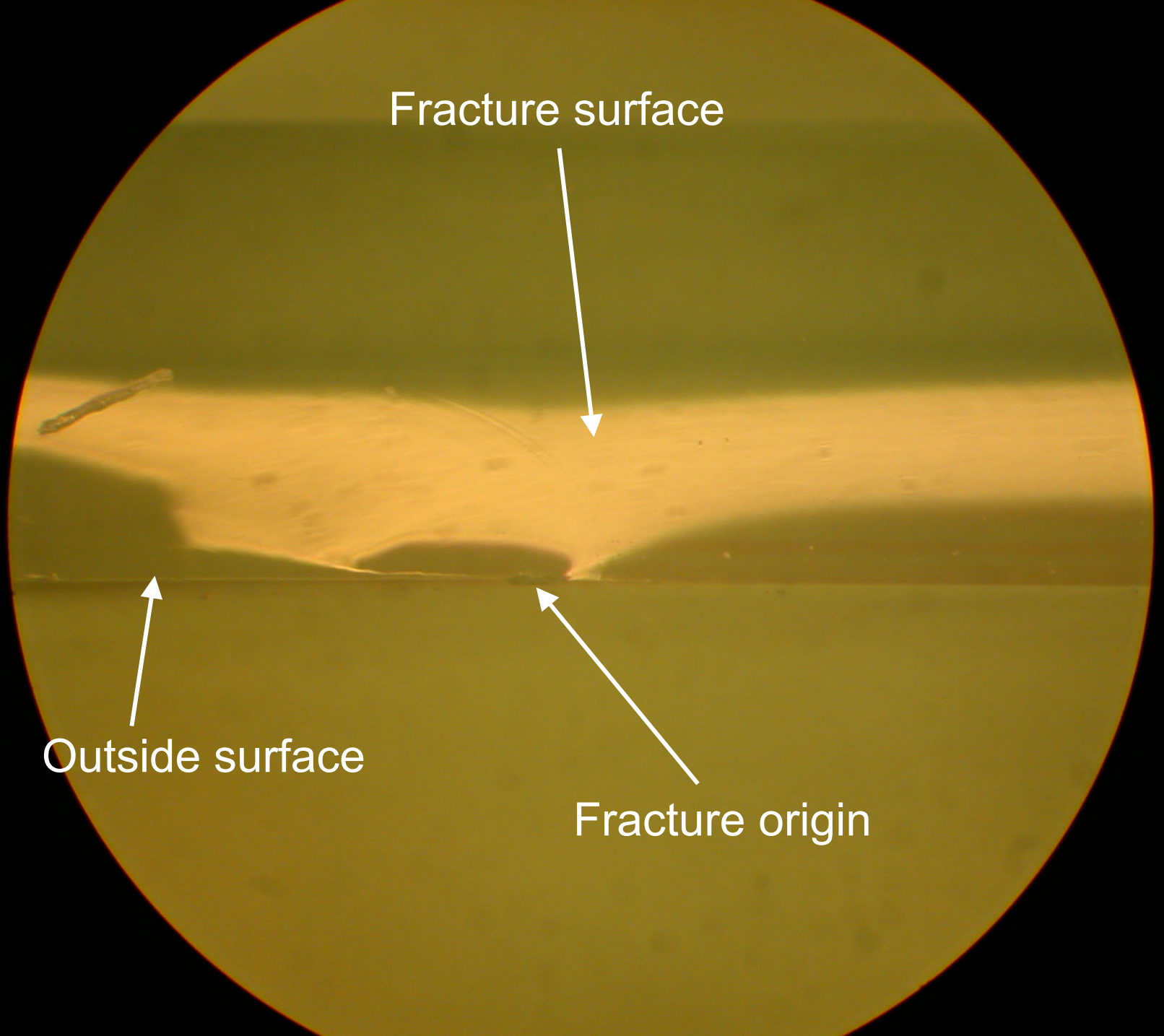




Fracture surface

Outside surface

Fracture origin

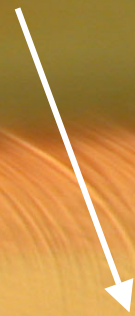


Fracture surface

Outside surface

Fracture origin

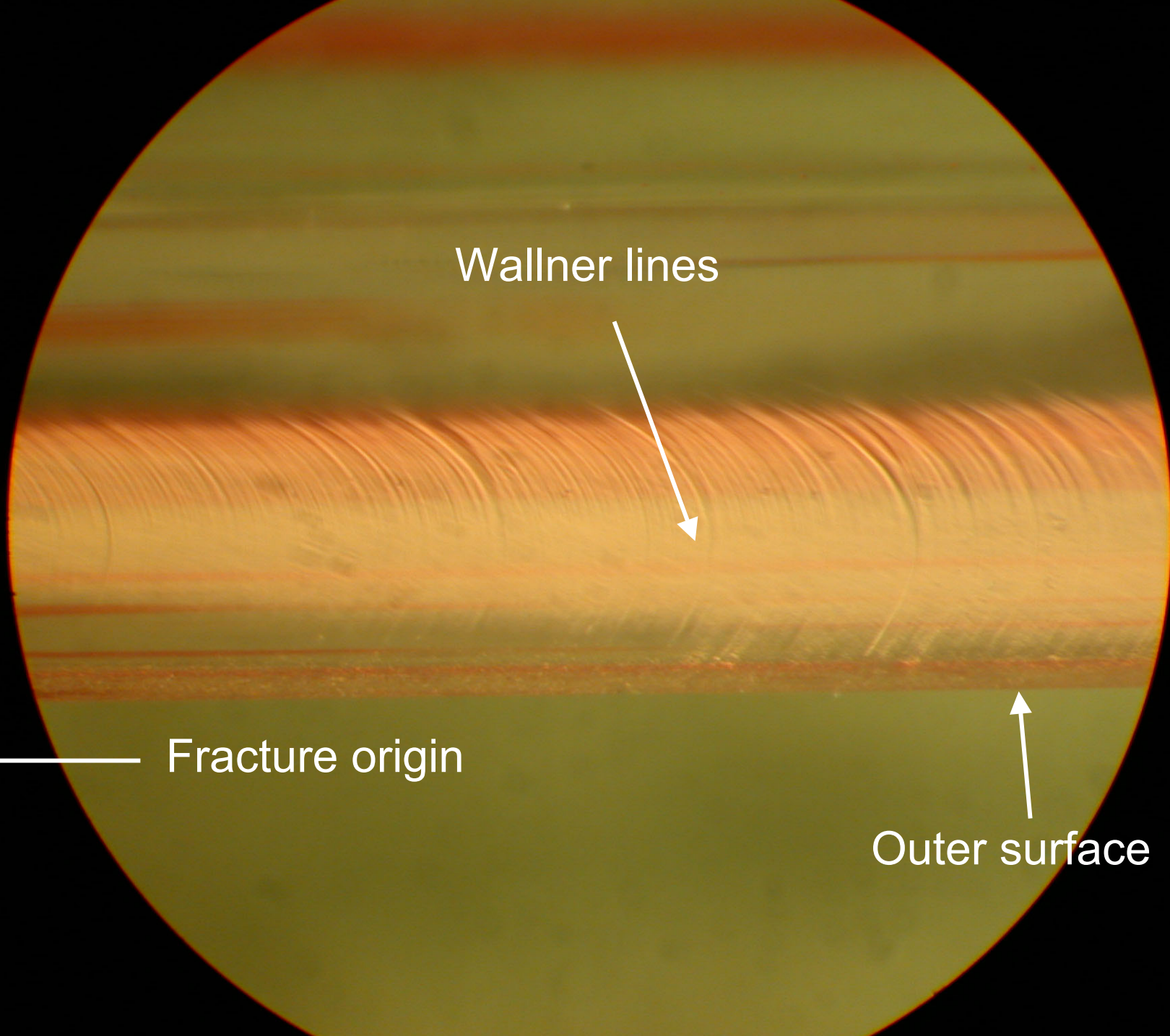
Wallner lines

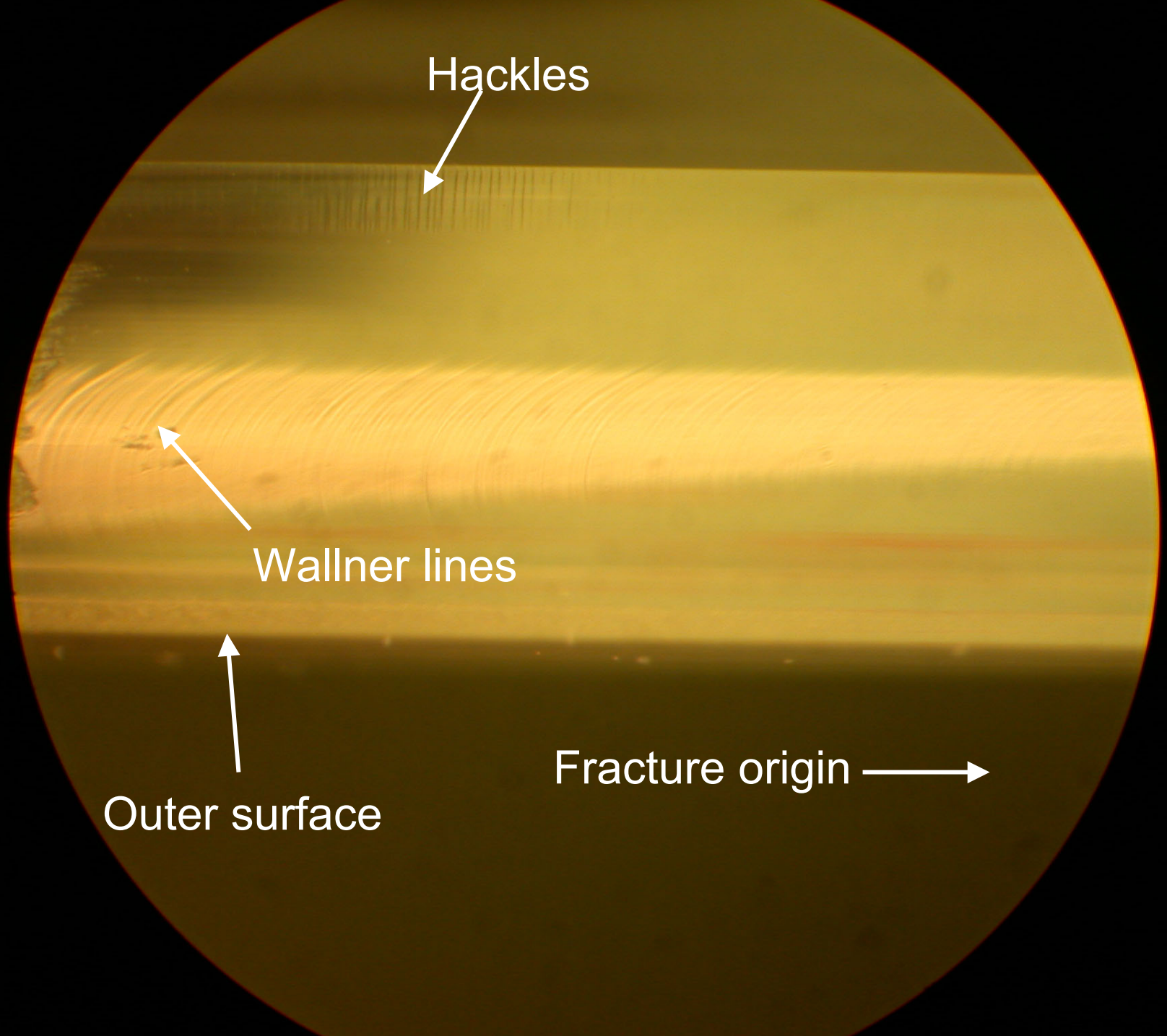


Fracture origin



Outer surface





Hackles



Wallner lines



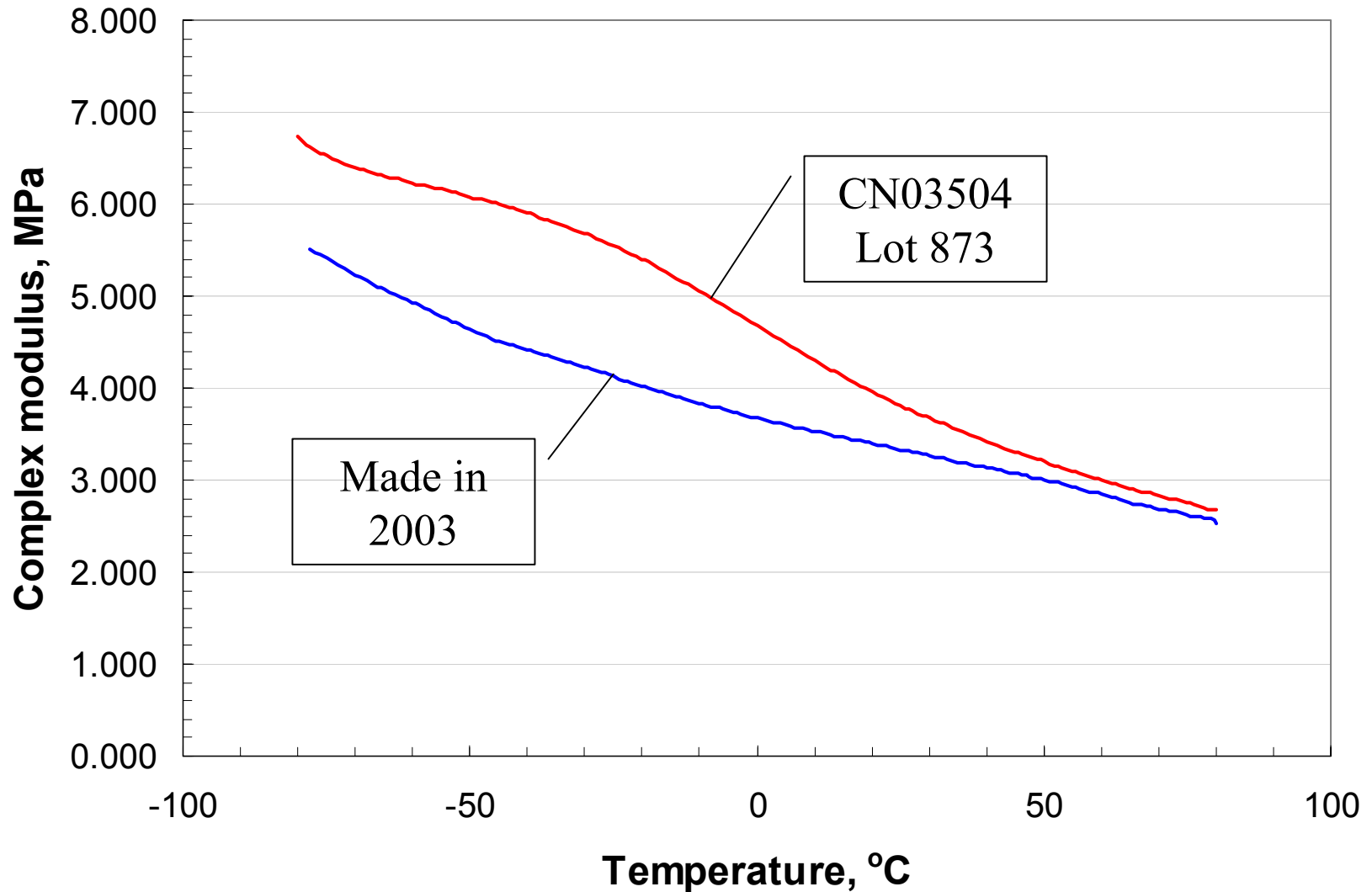
Outer surface



Fracture origin

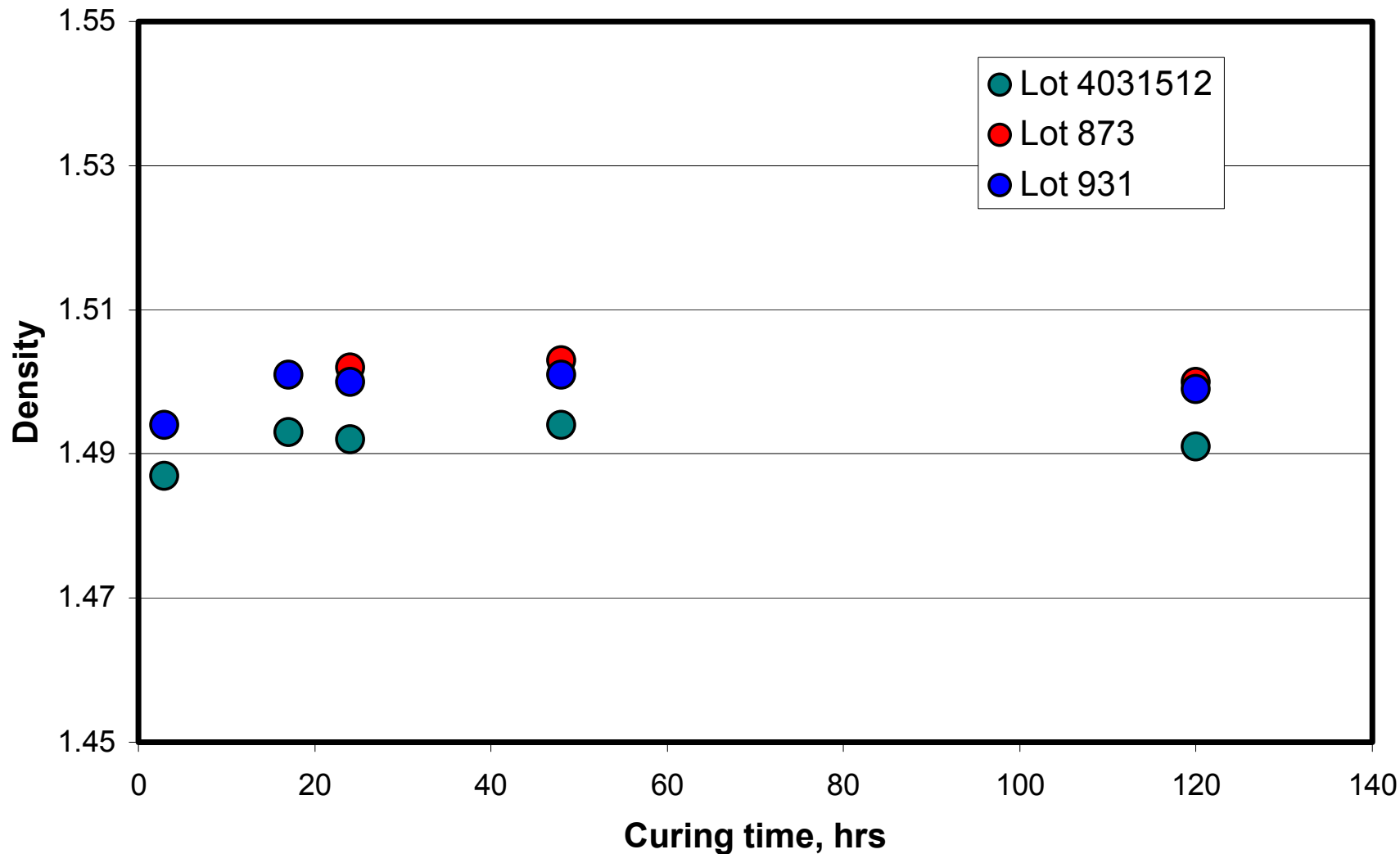


Modulus of RTV566



Curing Shrinkage

Mark McLendon



Summary

- Both failed NG tubes (AA0393 & ZL1193, 12 cycles between -30°C and +45°C) fractured from outside surface flaws
- Modulus of RTV varies between lots, but not significantly.
- Curing shrinkage about 0.2% (volume), mostly in the first 24 hrs.